REMARKS

Claims 1-41, as amended, remain herein.

Attached is a Request for Approval of Drawing Changes which requests approval of the proposed changes to Figs. 5, 10 and 11 as shown in red.

The specification has been amended to correct typographical errors which occurred during translation. The claims have been amended to eliminate multiply dependent claims.

Examination of this application on its merits is respectfully requested.

Respectfully submitted,

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Date

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Attachment:
Mark Up of Abstract,
Specification and Claims

RWP/ame

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(Explanations of Letters or Numerals)

1, 101, 102 ... Thin-Film Transistors (TFTs)

111 ... Diode

2, 21, 22 ... Image Signal Lines

3, 31, 32 ... Scan Signal Lines

40 ... Liquid Crystal Molecule

4 ... Liquid Crystal Layer

45 ... Impurity Ion

5 ... Accumulated Capacitance

6 ... Pixel Electrode

60, 61, 62 ... Pixel Electrodes

7, 71, 72 ... Source Electrodes

8, 81, 82 ... Drain Electrodes

11, 12 ... Gate Electrodes

14 ... Channel Protective Film

15 ... Semiconductor Layer

9 ... Substrate

90 ... Upper Substrate (Upper Electrode)

91 ... Lower Substrate (Lower Electrode)

92 ... Counter Electrode

93 ... Polarizing Plate

94 ... Polarizing Plate, Reflecting Plate

from the TFTs in the conventional structure. Consequently, the ability to charge each of the pixels is no more different from one scan signal line to another.

It will be appreciated that an alignment shift perpendicular to the scan signal lines exerts no influence on the structure shown in FIG. 4.

Although the drain and source electrodes of the TFT in the lower part of the drawing have slightly irregular configurations in the present embodiment, they present no particular problem (in practical use). However, it will be understood that compensation may be provided for the size of the pixel or the like.

(Embodiment 3)

The present embodiment is characterized in that the gate electrodes of TFTs adjoining along the scan signal lines are connected to the different scan signal lines.

FIG. 10 shows a liquid crystal display panel according to the present embodiment. The present embodiment also aims at a liquid crystal display panel for performing pseudo dot inversion driving shown in (2) of FIG. 2. FIG. 10 shows two pixels adjoining along the scan signal lines on the panel. Each of the first and second TFTs 101 and 102 has a gate electrode 11, a source electrode, a drain electrode, and a channel protective film 14. The depiction of the accumulated capacitances and the accumulated capacitance lines is omitted.

The first TFT 101 has the source electrode 71 connected to the first image signal line 21, the gate electrode 11 connected to a first scan line 31, and

the drain electrode 81 connected to a pixel electrode 6. The second TFT 102 has the source electrode 72 connected to the second image signal line 22, the gate electrode ~~11~~ 12 connected to a second scan signal line 32, and the drain electrode 82 connected to the pixel electrode.

As a consequence, the source and drain electrode 71, 81, 72, and 82 of the two TFTs are arranged in this order along the image signal lines (from top to bottom) in FIG. 10.

In the structure also, charging abilities are no more different from one TFT to another even if an alignment shift occurs between the individual layers and excellent image display can be performed, similarly to the first embodiment.

(Embodiment 4)

The present embodiment is characterized in that the source and drain electrodes of the TFTs are arranged in succession along the scan signal lines.

FIG. 11 shows the present embodiment. The present embodiment also relates to a liquid crystal display panel for performing pseudo dot inversion driving shown in (2) of FIG. 2, similarly to the preceding third embodiment.

In contrast to the preceding embodiment shown in FIG. 10 in which the source and drain electrodes 71 and 81 and the source and drain electrodes 72 and 82 are arranged in this order from top to bottom along the image signal lines, the source and drain electrodes 71 and 81 and the source electrode and drain electrodes 72 and 82 are arranged in this order from left to right along the scan signal lines in the present embodiment shown in FIG. 11.

In the structure also, charging abilities are no more different from one

TFT to another even if an alignment shift occurs between the individual layers and excellent image display can be performed for the same reasons as described in the first embodiment.

(Embodiment 5)

The present embodiment forms TFTs on the scan signal lines.

FIG. 12 shows the present embodiment. The TFT 1 formed within the pixel in the first embodiment shown in FIG. 8 (FIG. 1) is placed outside the scan signal line 3. Even if a TFT is formed on a scan line as in the present embodiment, the source and drain electrodes of the TFT can be arranged along the image signal lines in the order as shown in the first embodiment. This achieves the same effects as described in the first embodiment. The arrangement also allows the designing of a pixel having a large area and bright display by increasing the aperture ratio of the liquid crystal display panel.

It is also possible to place the TFT on the scan signal line in the other embodiments. Even if the placement is applied to the other embodiments, the charging abilities of the TFTs have no difference therebetween irrespective of an alignment shift and uniform display can be performed. In addition, the increased aperture ratio provides bright display.

(Embodiment 6)

The present embodiment relates to a liquid crystal panel in a transverse electric field mode.

Each of the foregoing embodiment has described the case where the

pixel electrodes and the common electrode opposed to the pixel electrodes are formed on the different substrates. However, the same effects are achievable with a liquid crystal display panel in a transverse electric field mode such as an IPS (In-Plane Switching) mode in which the pixel electrodes and the common electrode are formed on a single substrate as shown in FIG. ~~11~~ 13, in an FFS mode, or in an HS mode.

The present embodiment will be described briefly with reference to FIG. 13. In FIG. 13 is shown a view obtained by viewing the liquid crystal panel from above. The source electrodes 71 and 72 of the TFTs 101 and 102 of the upper and lower two electrodes are connected to the adjacent image signal lines 71 and 72, similarly to FIG. ~~7~~ 8. In the drawing, 92 denotes a common electrode formed on a single (opposite to the user side and lower) substrate and 6 denotes each of pixel electrodes which are connected to the drain electrode 81 and 82 of the TFTs 101 and 102.

As for the description of the principle and mechanism of a liquid crystal in the transverse electric field mode, FFS mode, HS mode, or the like, the description thereof is omitted since it is so-called well-known technology.

(Embodiment 7)

The present embodiment uses channel-etched TFTs.

Although each of the foregoing embodiments has described the case of using the channel-protected TFTs, the present invention is not limited thereto. The channel-etched TFTs may also be used in the FFS, HS, or other mode. In (1) to (5) of FIG 14. are shown cases where the channel-etched TFTs are used. Those shown in (1) to (5) of FIG. 14 correspond to FIGS. ~~6 to 10~~ 8 to 12and

have the semiconductor layer 15 patterned instead of using the channel protective film.

In the arrangement of the TFTs of the present invention also, the areas occupied by the overlapping portions between the semiconductor layers 15 and the source and drain electrodes 71, 72, 81, and 82 are no more different from one pixel to another even in the case of using the channel-etched TFTs, similarly to the case of using the channel-protected TFTs. This allows excellent image display.

(Embodiment 8)

The present embodiment relates to so-called U-shaped TFTs in each of which the number of at least one of the source and drain electrodes is plural.

In FIGS. 15 to 20 are shown the arrangements of image signal lines, pixel signal lines, and the source, drain, and gate electrodes of adjacent two TFTs of the present embodiment which are paired up in the longitudinal or lateral directions or the overlapping relations among portions related to the capacitances of the TFTs when viewed from above the substrate.

In FIG. 15, the two TFTs arranged laterally between the adjacent two image signal lines have source electrodes connected to the different image signal lines. In FIG. 16, the two TFTs arranged longitudinally between the adjacent two scan signal lines have gate electrodes connected to the different ~~scan~~ image signal lines. Each of the TFTs shown in FIG. 15 which have the respective source electrodes connected to the different scan signal lines between the adjacent two image signals lines is provided with two source electrodes 7. Each of the TFTs shown in FIG. 16 which have the respective

gate electrodes connected to the different scan signal lines between the adjacent two scan signal lines is provided with two source electrodes 7. The two electrodes 7 have the drain electrode 8 interposed midway therebetween. As a result, it is no more necessary to select between landscape and portrait orientations.

It will be appreciated that, in each of FIGS. 15 and 16, the number of the source electrodes and that of the drain electrodes are interchangeable and the positional relationship between the source and drain electrodes is reversible. Although 15 denotes the semiconductor layer of the channel-etched TFT in FIG. 16 and the like, 15 denotes a channel protective film if a channel-protected TFT is used instead.

In each of FIGS. 17 to 20, two source electrodes and two drain electrodes are provided and arranged equidistantly in the lateral or longitudinal direction. The semiconductor layer or the overlying insulating film 14 is configured as an elongated square so that the areas of overlapping portions with the source and drain electrodes do not change even if a slight alignment shift occurs in the direction of the shorter sides (lateral direction) of the semiconductor layer or the insulating film 14. The shorter side portions of the semiconductor layer or the insulating film 14 in the longitudinal or lateral direction extend to a region near the center portions of the source or drain electrodes which are also elongated in the lateral or longitudinal direction so that the characteristics of the two TFTs do not vary or vary equally even if a slight alignment shift occurs in the direction of the longer sides (longitudinal direction).

Although one TFT has two source electrodes and two drain electrodes

(Embodiment 12)

The present embodiment relates to a method for driving each of the liquid crystal display panels in the foregoing third and fourth embodiments.

In (3) and (4) of FIG. 23 is shown a circuit of the present embodiment.

The polarities of the image signal voltages impressed on the image signal lines 2 are alternately switched as shown in (3) of FIG. 23 during a horizontal scan period during which a certain scan line is scanned, in (4) of FIG. 23 during another horizontal scan period during which the subsequent scan line is scanned, and in (3) of FIG. 23 during a still another horizontal scan period during which the subsequent scan line is scanned (the polarities of the image signal voltages are inverted on a per horizontal-scan-period basis such that positive and negative polarities alternate). As a result, voltages of different polarities are written reliably in the adjacent two pixels in the liquid crystal display panel as shown in FIG.3 so that pseudo dot inversion driving is performed.

(Embodiment 13)

The present embodiment relates to an improvement in color display characteristics in pseudo dot inversion display. If the arrangement of three primary colors on a color display panel is in a mosaic pattern, the primary colors of red (R), green (G), and blue (B) are repeatedly arranged in this order in oblique directions so that, if red is used as an example, lines in positive (+) display and lines in negative (-) display are arranged alternately. This causes a problem if the color display panel is used by those particular with color or for professional purposes. In the arrangement in stripes, however, the positive

and negative displays are repeated on a per pixel basis in a longitudinal (or lateral) red stripe and the repetition of the positive and negative displays is shifted by one pixel position in an adjacent red stripe disposed ~~three~~ two lines apart. This achieves more preferable red display.

The technology is shown in FIG. 25. In (1) of FIG. 25 is shown the distribution of the positive and negative polarities of the individual pixels in pseudo dot conversion. The technology is basically the same as shown in FIG. 3 so that ○ represents the positive or negative polarity and the polarity of each of the pixels is inverted on a per display period basis. In (2) of FIG. 25 is shown the placement of the positive and negative polarities of red pixels which are arranged in a mosaic pattern. In this case, the groups of red pixels of the positive polarities and the groups of red pixels of the negative polarities are arranged alternately in oblique directions as shown on the right side of (2) of FIG. 25. Likewise, the case of longitudinal stripes is shown in (3) of FIG. 25.

(Embodiment 14)

The present embodiment relates to the case of liquid crystal logic elements.

In recent years, an optical logic element 67 for outputting, as transmitted light 66, the result of an arithmetic operation performed with respect to incident light 65 has been developed, as shown in FIG. 26. In an application to an optical computer, the optical logic element is required to have high reliability and performance. In this case also, high reliability and performance satisfying the requirements has been obtained by combining the technologies described in the foregoing embodiments.

protective film and the drain electrode and a variation in an overlapping area between the channel protective film and the source electrode responsive to the alignment shift is constant or equal.

8. The liquid crystal device of claim 2, each of the two thin film transistors is an overlapping-area-compensated thin-film transistor formed as means for compensating for at least one of a variation in the capacitance between the gate and drain electrodes and a variation in the capacitance between the gate and source electrodes caused by the alignment shift such that at least one of a variation in an overlapping area between a channel protective film and the drain electrode and a variation in an overlapping area between the channel protective film and the source electrode responsive to the alignment shift is constant or equal.

9. The liquid crystal device of ~~any one of claims 1, 3, 5, and 7~~ claim 1, wherein, if the source and drain electrodes of the first one of the two thin-film transistors connected to the first one of the image signal lines are S1 and D1 and the source and drain electrodes of the second one of the two thin-film transistors connected to the second one of the image signal lines are S2 and D2, the four electrodes are arranged along the image signal lines in the order of S1, D1, S2, and D2 or D1, S1, D2, and S2.

10. The liquid crystal device of ~~any one of claims 1, 3, 5, and 7~~ claim 1, wherein, if the source and drain electrodes of the first one of the two thin-film transistors connected to the first one of the image signal lines are S1 and D1 and the source and drain electrodes of the second one of the two thin-film transistors connected to the second one of the image signal lines are S2 and D2, the four electrodes are arranged along the scan signal lines in the order of S1,

D1, S2, and D2 or D1, S1, D2, and S2.

11. The liquid crystal device of ~~any one of claims 2, 4, 6, and 8~~ claim 2, wherein, if the source and drain electrodes of the first one of the two thin-film transistors connected to the first one of the scan signal lines are S1 and D1 and the source and drain electrodes of the second one of the two thin-film transistors connected to the second one of the scan signal lines are S2 and D2, the four electrodes are arranged along the scan signal lines in the order of S1, D1, S2, and D2 or D1, S1, D2, and S2.

12. The liquid crystal device of ~~any one of claims 2, 4, 6, and 8~~ claim 2, wherein, if the source and drain electrodes of the first one of the two thin-film transistors connected to the first one of the scan signal lines are S1 and D1 and the source and drain electrodes of the second one of the two thin-film transistors connected to the second one of the scan signal lines are S2 and D2, the four electrodes are arranged along the image signal lines in the order of S1, D1, S2, and D2 or D1, S1, D2, and S2.

13. The liquid crystal device of ~~any one of claims 1, 3, and 5~~ claim 1, wherein each of the two thin-film transistors is such that the source electrode or electrodes are larger in number than the drain electrode or electrodes thereof or the drain electrode or electrodes are larger in number than the source electrode or electrodes;

the source and drain electrodes are arranged alternately in parallel with the scan signal lines;

the source and drain electrodes have both ends extending off at least one of the semiconductor layer and a channel protective film in directions along the scan signal lines when viewed from above an upper surface of the

substrate; and

those ones of the electrodes which are larger in number than the other electrode or electrodes include two located at both ends in directions along the image signal lines and extending off at least one of the semiconductor layer and the channel protective film in directions opposite to the directions along the image signal lines when viewed from above the upper surface of the substrate.

14. The liquid crystal device of ~~any one of claims 2, 4, and 6~~ claim 2, wherein each of the two thin-film transistors is such that the source electrode or electrodes are larger in number than the drain electrode or electrodes thereof or the drain electrode or electrodes are larger in number than the source electrode or electrodes;

the source and drain electrodes are arranged alternately in parallel with the scan signal lines;

the source and drain electrodes have both ends extending off at least one of the semiconductor layer and a channel protective film in directions along the scan signal lines when viewed from above an upper surface of the substrate; and

those ones of the electrodes which are larger in number than the other electrode or electrodes include two located at both ends in directions along the image signal lines and extending off at least one of the semiconductor layer and the channel protective film in directions opposite to the directions along the image signal lines when viewed from above the upper surface of the substrate.

15. The liquid crystal device of claim 1, wherein each of the two thin-

one of the semiconductor layer and a channel protective film in directions along the scan signal lines when viewed from above an upper surface of the substrate; and

those ones of the source and drain electrodes located at both ends in directions along the image signal lines extend off at least one of the semiconductor layer and the channel protective film in directions opposite to the directions along the scan signal lines when viewed from above the upper surface of the substrate.

19. The liquid crystal device of claim 1, wherein the two thin-film transistors have the respective two drain electrodes each composed of a thin-film semiconductor such that overlapping portions between the two drain electrodes and the gate electrodes are formed in the same directions relative to directions along the scan signal lines when viewed from above an upper surface of the substrate.

20. The liquid crystal device of ~~any one of claims 1, 3, 5, 7, 15, 16, and 19~~ claim 1, comprising pseudo-dot-inversion implementing means for impressing image signal voltages of opposite polarities on the adjacent two image signal lines.

21. The liquid crystal device of claim 9, comprising pseudo-dot-inversion implementing means for impressing image signal voltages of opposite polarities on the adjacent two image signal lines.

22. The liquid crystal device of claim 10, comprising pseudo-dot-inversion implementing means for impressing image signal voltages of opposite polarities on the adjacent two image signal lines.

23. The liquid crystal device of claim 13, comprising pseudo-dot-

inversion implementing means for impressing image signal voltages of opposite polarities on the adjacent two image signal lines.

24. The liquid crystal device of claim 20, comprising frame-polarity inverting means for inverting the polarities of the image signal voltages impressed on the individual image signal lines over an entire frame on a per predetermined-number-of-frames basis.

25. The liquid crystal device of claim 21, comprising frame polarity inverting means for inverting the polarities of the image signal voltages impressed on the individual image signal lines over an entire frame on a per predetermined-number-of-frames basis.

26. The liquid crystal device of claim 22, comprising frame polarity inverting means for inverting the polarities of the image signal voltages impressed on the individual image signal lines over an entire frame on a per predetermined-number-of-frames basis.

27. The liquid crystal device of claim 23, comprising frame polarity inverting means for inverting the polarities of the image signal voltages impressed on the individual image signal lines over an entire frame on a per predetermined-number-of-frames basis.

28. The liquid crystal device of ~~any one of claims 2, 4, 6, 7, 8, and 18~~ claim 2, comprising pseudo-dot-inversion implementing means for impressing image signal voltages of the same polarities on the image signal lines during the same scan period and inverting the polarities of the voltages on a per specified-horizontal-scan-period basis.

29. The liquid crystal device of claim 11, comprising pseudo-dot-inversion implementing means for impressing image signal voltages of the

ABSTRACT OF THE DISCLOSURE

In a liquid crystal panel in which pseudo dot inversion driving is performed, the occurrence of flicker or vertical and horizontal strings is prevented by preventing an alignment shift between individual layers during the fabrication of a TFT array from producing a difference between the respective abilities of thin-film TFTs to charge adjacent pixels (61, 62). For this purpose, the liquid crystal display panel is constructed such that two TFTs which are enclosed by two adjacent image signal lines (21, 22) and scan signal lines (3) and adjacent to each other along the signal lines (21, 22) have respective source electrodes (71, 72) ~~adjacent~~ connected to the different image signal lines (21, 22). The source electrodes (71, 72) and drain electrodes (81, 82) of the two TFTs connected to the adjacent pixels (61, 62) are alternately arranged such that variations caused by the alignment shift in the sizes and areas of overlapping portions between the individual layers of the TFTs are equal or the same.